B. MECHANICAL 1ST YR 2ND SEMESTER EXAMINATION 2019 (Old)

FLUID MECHANICS - I

Time: Three Hours **Full Marks: 100**

All the parts of a question** should be **answered together.
Assume any relevant data** if necessary **with suitable justifications.
***Notations** should be **properly described** along with the **necessary sketches** whenever applicable.*
Symbols used in the questions carry their usual meanings.

Module: 1 (25 Marks)

1. Answer **ANY FIVE** **[5x5 = 25]**

Write short notes on the following.

i) Classification of fluid flow
ii) Streamline and Streakline
iii) Significance of Moody diagram
iv) Pitot tube
v) Orifice meter
vi) V-notch

Module: 2 (30 Marks)

Answer **ANY THREE**

2. Derive continuity equation in general form. Further, write down the appropriate form for unsteady one-dimensional compressible flow. **[7+3]**

3. Derive Bernoulli's equation, clearly mentioning required assumptions. **[7+3]**

4. Derive Hagen-Poiseuille's velocity profile for the flow between two parallel plates, and find the ratio of maximum velocity to mean velocity. **[7+3]**

5. Stating the flow condition/assumptions, derive Chezy's equation for open channel flow and relate it with Manning's formula. **[7+3]**

Module: 3 (36 Marks)

Answer **ANY FOUR**

6. A shaft of diameter 0.1 m rotates at 180 rpm inside a bearing filled with lubricating oil (of viscosity 5 poise) and having a sleeve length of 100 mm. Calculate the frictional force and the power lost in the bearing if the thickness of the oil film is 2 mm. **[6+3]**

7. Find the resultant thrust acting on the face of a tainter gate of 90° sector as shown in Fig. 1. Take width of the gate to be unity.

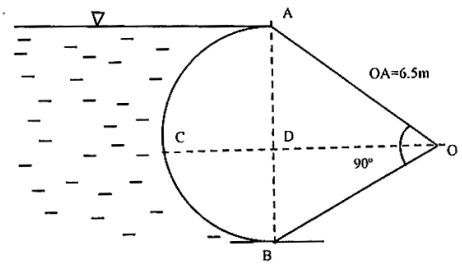

Fig.1

[9]

8. Stream function, $\psi = xy$, is given for a two-dimensional incompressible flow. Test the feasibility of this flow and confirm whether the flow is rotational or irrotational. If applicable, find the expression of velocity potential function, ϕ. **[9]**

9. A bend (fitted in a pipeline conveying water) reduces gradually from 0.3 m to 0.2 m diameter and deflects flow through an angle of 45°. The gauge pressure at larger end is 170 kPa and corresponding flow is 800 litres/second. Determine the magnitude and direction of the force exerted on the bend. **[9]**

10. A pipe of 60 mm diameter and 450 m long has upward slope at 1 in 50. An oil (of viscosity 0.9 Ns/m^2 and specific gravity 0.9) is required to be pumped through this pipe at a rate of 5 litres/s. (i) Is this flow laminar? (ii)What pressure difference is required to attain this condition? (iii) What power of the pump is required if overall efficiency is 65%? **[9]**

Module: 4 (9 Marks)

Answer **ANY ONE**

11. (i) A pitot-static tube placed in the centre of a 200 mm pipeline, has one orifice pointing upstream and the other perpendicular to it. If the pressure difference between the two orifices is 40 mm of water when the discharge through the pipe is 1365 litres per minute, calculate the coefficient of the pitot tube. Take the mean velocity in the pipe to be 83% of central velocity.

    (ii) A right-angled V-notch was used for measuring a discharge of 60 litres/sec. An error of 3 mm was made while measuring the head over notch. Calculate the percentage error in the discharge. Take Cd = 0.62. **[5+4]**

12. A venturi meter is installed in a vertical pipe that carries petrol (of specific gravity 0.78) upward at a rate of 0.029 m^3/s. The inlet and throat diameters of the meter are respectively 150 mm and 75 mm. The throat is 250 mm above the inlet and Cd = 0.96. Find the pressure difference between the inlet and the throat. **[9]**